

Soil Moisture Data Assimilation in the NASA Land Information System for Local Modeling Applications and Improved Situational Awareness

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As part of the NASA Soil Moisture Active Passive (SMAP) Early Adopter (EA) program, the NASA Short-term Prediction Research and Transition (SPoRT) Center has implemented a data assimilation (DA) routine into the NASA Land Information System (LIS) for soil moisture retrievals from the European Space Agency's Soil Moisture Ocean Salinity (SMOS) satellite. The SMAP EA program promotes application-driven research to provide a fundamental understanding of how SMAP data products will be used to improve decision-making at operational agencies. SPoRT has partnered with select NOAA/NWS Weather Forecast Offices (WFOs) that use output from a real-time regional configuration of LIS, without soil moisture DA, to initialize local numerical weather prediction (NWP) models and enhance situational awareness. Improvements to local NWP with the current LIS have been demonstrated; however, a better representation of the land surface through assimilation of SMOS (and eventually SMAP) retrievals is expected to lead to further model improvement, particularly during warm-season months. SPoRT will collaborate with select WFOs to assess the impact of soil moisture DA on operational forecast situations.

Assimilation of the legacy SMOS instrument data provides an opportunity to develop expertise in preparation for using SMAP data products shortly after the scheduled launch on 5 November 2014. SMOS contains a passive L-band radiometer that is used to retrieve surface soil moisture at 35-km resolution with an accuracy of $0.04 \text{ cm}^3 \text{ cm}^{-3}$. SMAP will feature a comparable passive L-band instrument in conjunction with a 3-km resolution active radar component of slightly degraded accuracy. A combined radar-radiometer product will offer unprecedented global coverage of soil moisture at high spatial resolution (9 km) for hydrometeorological applications, balancing the resolution and accuracy of the active and passive instruments, respectively. The LIS software framework manages land surface model (LSM) simulations and includes an Ensemble Kalman Filter for conducting land surface DA. SPoRT has added a module to read, quality-control and bias-correct swaths of Level II SMOS soil moisture retrievals prior to assimilation within LIS. The impact of SMOS DA is being tested using the Noah LSM.

Experiments are being conducted to examine the impacts of SMOS soil moisture DA on the resulting LIS-Noah fields and subsequent NWP simulations using the Weather Research and Forecasting (WRF) model initialized with LIS-Noah output. LIS-Noah soil moisture will be validated against in situ observations from Texas A&M's North American Soil Moisture Database to reveal the impact and possible improvement in soil moisture trends through DA. WRF model NWP case studies will test the impacts of DA on the simulated near-surface and boundary-layer environments, and precipitation during both quiescent and disturbed weather scenarios. Emphasis will be placed on cases with large analysis increments, especially due to contributions from regional irrigation patterns that are not represented by precipitation input in the baseline LIS-Noah run. This poster presentation will describe the soil moisture DA methodology and highlight LIS-Noah and WRF simulation results with and without assimilation.